

Establishing Water Quality-based Effluent Limitations in NPDES Permits: Part II—Characterize the Effluent and Receiving Water

Today's Speakers

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WQBELs Part II-2

Establishing WQBELs in NPDES Permits

Part I: Identify Applicable Water Quality Standards

Part II: Characterize the Effluent and Receiving Water

Part III: Determine the Need for WQBELs

Part IV: Calculate Chemical-specific WQBELs
and Determine Final Limitations



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Components of Water Quality Standards

Components of water quality standards include:

- Designated uses [§131.10]
- Water quality criteria [§131.11]
- Antidegradation policy [§131.12]
- General policies [§131.13] (optional)



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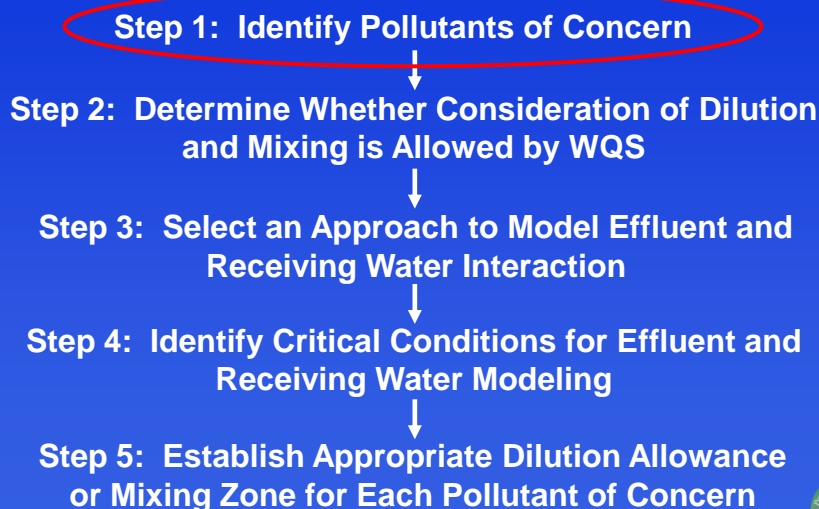
WQS Implementation Procedures

- Water quality standards and their implementing procedures (including NPDES requirements) specify methods for determining the need for WQBELs and for calculating WQBELs that ensure that standards are attained.
- Where can these methods be found?
 - state regulations
 - state water quality management plans
 - state guidance
 - EPA's *Technical Support Document*



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Characterize the Effluent and Receiving Water



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Step 1: Identify Pollutants of Concern

- Pollutants of concern are pollutants:
 - *With an applicable TBEL*



§ 433.14 Effluent limitations representing the degree of effluent reduction attainable by applying the best available technology economically achievable (BAT).

(a) Except as provided in 40 CFR 125.90 through 125.92, any existing point source subject to this subpart must achieve the following effluent limitations representing the degree of effluent reduction attainable by applying the best available technology economically achievable (BAT):

BAT EFFLUENT LIMITATIONS

Pollutant or pollutant property	Maximum for any 1 day	Monthly average shall not exceed
Milligrams per liter (mg/l)		
Cadmium (T)	0.09	0.26
Chromium (T)	2.77	1.71
Copper (T)	3.98	2.07
Lead (T)	0.69	0.43
Nickel (T)	3.98	2.36
Silver (T)	0.43	0.24
Zinc (T)	2.61	1.48
Cyanide (T)	1.20	0.65
TTO	2.19	



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Step 1: Identify Pollutants of Concern

- Pollutants of concern are pollutants:
 - With an applicable TBEL
 - *With a WLA from a TMDL or watershed analysis*



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Total Maximum Daily Load (TMDL)

- **CWA section 303(d)(1)**
 - requires states, territories, and tribes to identify waters that will not achieve water quality standards after implementation of technology-based limitations
 - requires ranking of identified waters based on severity of pollution and uses
 - requires TMDL for priority waters



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Total Maximum Daily Load (TMDL) (Continued)

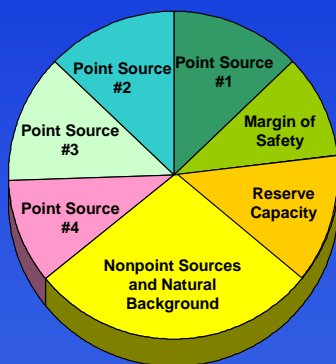
- Defined as the amount of a pollutant that may be discharged into a water body with the water body still meeting water quality standards
- Used as a tool for implementing water quality standards



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Components of TMDL

TMDL for Pristine Creek – Pollutant Z



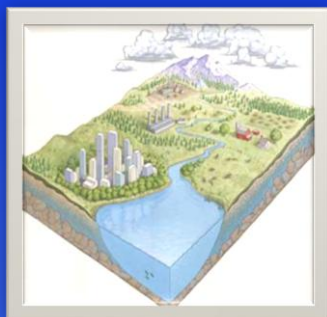
$TMDL = \sum WLA + \sum LA + \text{Margin of Safety}$
(also may include Reserve Capacity)

- Wasteload allocations (WLAs) are assigned to each point source discharge
- Load allocations (LAs) are assigned to nonpoint sources
- WLAs and LAs are established so that predicted receiving water concentrations do not exceed water quality criteria
- Margin of safety ensures that water can attain designated uses
- Reserve capacity may be included to account for new or expanded discharges



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Watershed Analysis



- Even where a TMDL is not required, a watershed analysis might consider all the sources of a pollutant or stressor contributing to the waterbody
- Like a TMDL, a watershed analysis could be used to:
 - identify point sources that need WQBELs
 - determine appropriate WLAs for those point sources



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Step 1: Identify Pollutants of Concern

- Pollutants of concern are pollutants:
 - With an applicable TBEL
 - With a WLA from a TMDL or watershed analysis
 - *Identified as needing WQBELs in the previous permit*



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Step 1: Identify Pollutants of Concern

- Pollutants of concern are pollutants:
 - With an applicable TBEL
 - With a WLA from a TMDL or watershed analysis
 - Identified as needing WQBELs in the previous permit
 - *Identified as present in the effluent through monitoring*



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Monitoring Data

- Pollutants of concern are pollutants:
 - With an applicable TBEL
 - With a WLA from a TMDL or watershed analysis
 - Identified as needing WQBELs in the previous permit
 - Identified as present in the effluent through monitoring
 - *Otherwise expected to be present in the discharge*



Characterize the Effluent and Receiving Water

Step 1: Identify Pollutants of Concern

Step 2: Determine Whether Consideration of Dilution and Mixing is Allowed by WQS

Step 3: Select an Approach to Model Effluent and Receiving Water Interaction

Step 4: Identify Critical Conditions for Effluent and Receiving Water Modeling

Step 5: Establish Appropriate Dilution Allowance or Mixing Zone for Each Pollutant of Concern



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Step 2: Dilution and Mixing Zones in WQS

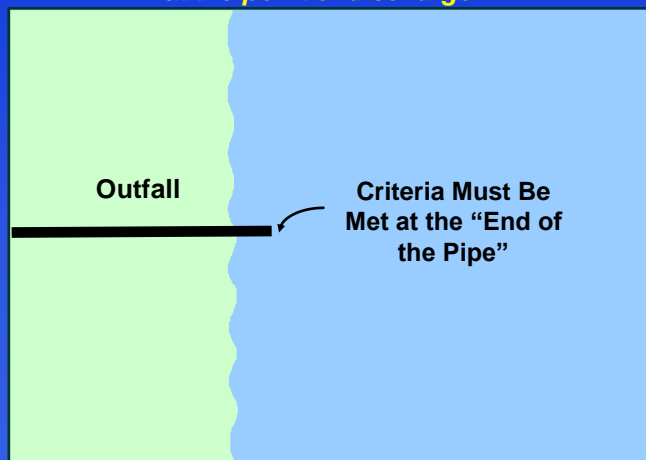
- Water quality standards:
 - generally allow dilution and mixing zones in applying water quality criteria
 - specify situations in which dilution and mixing zones may not be used



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No Dilution or Mixing Zone Allowed by WQS

If water quality standards **do not allow** consideration of dilution or mixing zones, water quality criteria must be attained at the **point of discharge**.

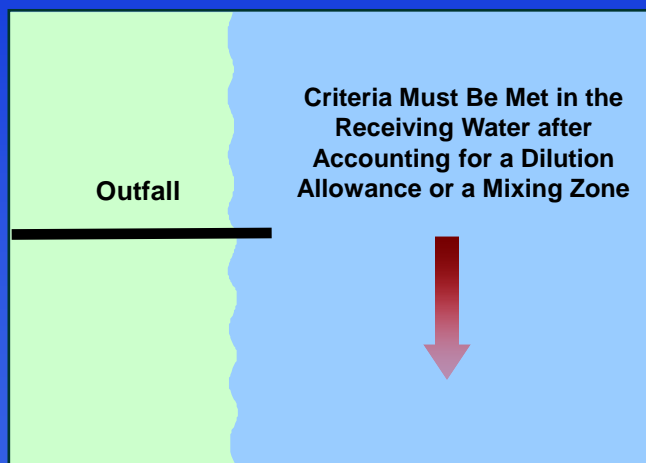


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Dilution or Mixing Zone Allowed by WQS

If standards **allow** consideration of dilution or mixing zones, water quality criteria must be met in the receiving water after accounting for allowable dilution or at the edge of the regulatory mixing zone.



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Characterize the Effluent and Receiving Water

Step 1: Identify Pollutants of Concern



Step 2: Determine Whether Consideration of Dilution and Mixing is Allowed by WQS



Step 3: Select an Approach to Model Effluent and Receiving Water Interaction



Step 4: Identify Critical Conditions for Effluent and Receiving Water Modeling



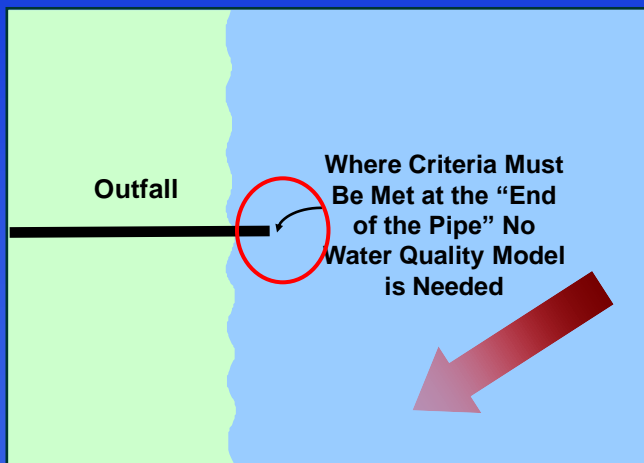
Step 5: Establish Appropriate Dilution Allowance or Mixing Zone for Each Pollutant of Concern



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Step 3: Select Modeling Approach

Where dilution or mixing is not considered, no water quality model is needed.



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Step 3: Select Modeling Approach



- Where dilution and mixing and the interaction of the effluent and receiving water are considered, there are two basic modeling techniques:
 - Dynamic modeling
 - Steady-state modeling



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Dynamic Modeling

- Accounts for **variability** of model inputs
- Projects **probability distributions** rather than a single value based on critical conditions
- **Data intensive** and more **complex** than steady-state modeling



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Steady-State Modeling

- Predicts the impact of the effluent on the receiving water for a **single set of conditions**
- Assumes **critical conditions** for flow, pollutant concentrations, and environmental effects
- If criteria are **not exceeded under critical conditions**, the discharge should not cause criteria to be exceeded under other conditions



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Characterize the Effluent and Receiving Water

Step 1: Identify Pollutants of Concern



Step 2: Determine Whether Consideration of Dilution and Mixing is Allowed by WQS



Step 3: Select an Approach to Model Effluent and Receiving Water Interaction



Step 4: Identify Critical Conditions for Effluent and Receiving Water Modeling



Step 5: Establish Appropriate Dilution Allowance or Mixing Zone for Each Pollutant of Concern



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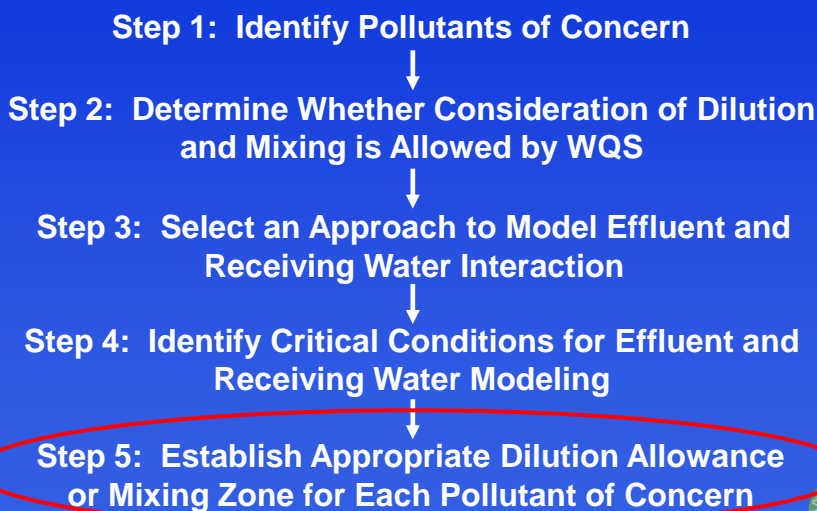
Step 4: Identify Critical Conditions

- **Effluent critical conditions:**
 - Effluent flow
 - Effluent pollutant concentrations (pollutants of concern)
- **Receiving water critical conditions:**
 - Receiving water flow (if applicable)
 - Background pollutant concentrations (pollutants of concern)
 - Other receiving water characteristics (e.g., temperature, pH, reaction rates)



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Characterize the Effluent and Receiving Water



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Step 5: Establish Dilution Allowance or Mixing Zone

- What type of mixing occurs under critical conditions?
 - rapid and complete mixing
 - incomplete mixing



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Step 5: Establish Dilution Allowance or Mixing Zone

What is rapid and complete mixing?

- Rapid and complete mixing occurs when lateral variation in concentration in the direct vicinity of the outfall is small
- Rapid and complete mixing occurs in rivers and streams under certain conditions
 - assumed
 - demonstrated



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Step 5: Establish Dilution Allowance or Mixing Zone

What is the allowable dilution when there is rapid and complete mixing in a river or stream?

- Water quality standards could allow as much as **100 percent of the critical low flow** as a dilution allowance when there is rapid and complete mixing
- Some water quality standards might apply a factor of safety and allow only **a portion of the critical low flow** even where there is rapid and complete mixing



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Step 5: Establish Dilution Allowance or Mixing Zone

What is incomplete mixing?

- Where rapid and complete mixing cannot be assumed or demonstrated, there is **incomplete mixing**
- Where there is incomplete mixing, a **mixing analysis** will be required to understand how the effluent and receiving water mix



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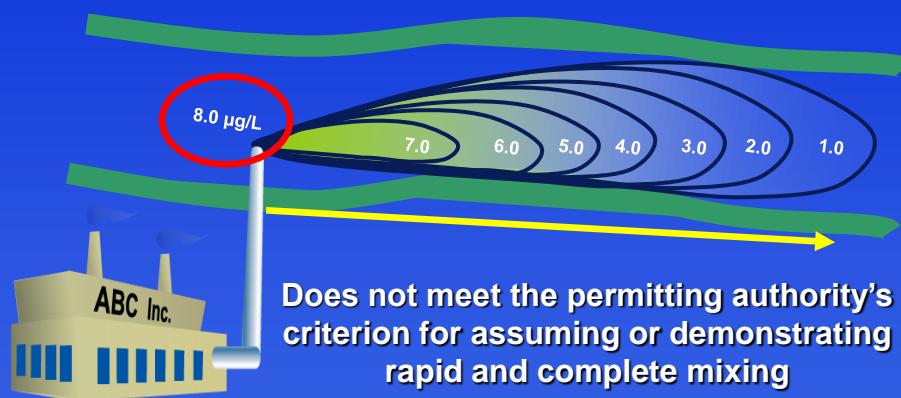
Mixing Analysis

- **Field Studies**
 - actual measurement of instream pollutant concentrations
 - dye studies
- **Water Quality Modeling**
 - calibrate model to actual observations
 - simulate mixing under critical conditions



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Example of Incomplete Mixing



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Step 5: Establish Dilution Allowance or Mixing Zone

What is the allowable dilution when there is incomplete mixing?

- Water quality standards might allow a permit writer to consider a **limited dilution allowance** or a **regulatory mixing zone** under critical conditions where there is incomplete mixing



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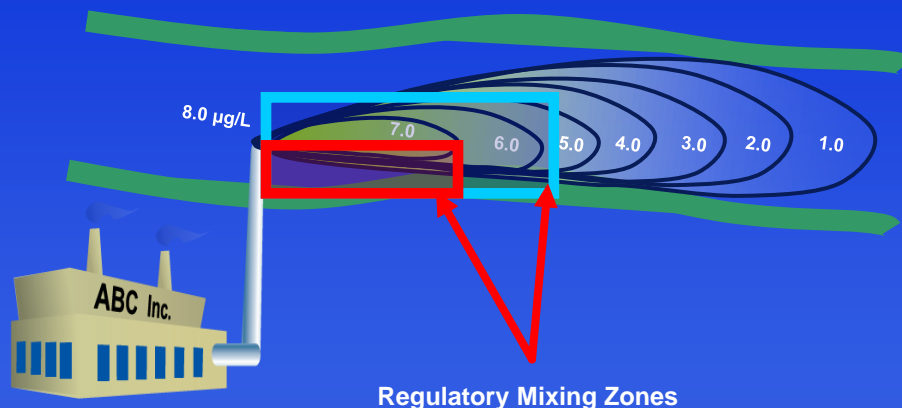
Step 5: Establish Dilution Allowance or Mixing Zone

- What is a regulatory mixing zone?
 - A **regulatory mixing zone** is a **limited area or volume of water** where initial dilution of a discharge takes place and within which the water quality standards allow certain water quality criteria to be exceeded



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Examples of Regulatory Mixing Zones



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Examples of Regulatory Mixing Zones



Examples of **maximum** mixing zone sizes or **maximum** dilution allowances under incomplete mixing conditions:

- Mixing zones may not be larger than 1/4 of the stream width and 1/4 mile downstream
- Mixing zones may not be larger than 5% of the lake surface
- Mixing zones may not be larger than 100 foot radius from the point of discharge
- Dilution allowances may not be larger than 1/3 of the critical low flow
- Dilution allowances may not be larger than 10:1 dilution for ocean discharges

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Step 5: Establish Dilution Allowance or Mixing Zone

- **Common Constraints on Mixing Zone Size**
 - may not impair integrity of the water body
 - no significant health risks
 - no lethality to passing organisms
- **Other Considerations**
 - multiple point and nonpoint sources
 - potential for overlapping mixing zones



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Feedback and Other Presentations

Questions or comments?

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